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Tactical Network Topology (TNT) Marine Interdiction Operation (MIO) TNT MIO 09-2 Environmental Effects Research

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Tactical Network Topology (TNT)
Marine Interdiction Operation (MIO)
TNT MIO 09-2
Environmental Effects Research

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Presented to the

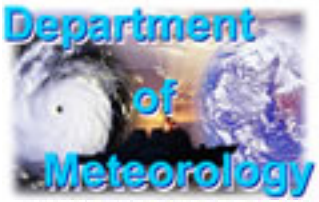
NPS Marine Domain Awareness Working Group

June 10, 2009

Outline

- The TNT/CBE Program at NPS
- TNT MIO History
- TNT MIO 09-2 April 2009 Overview
- Environmental Effects
  - Weather and Sea State Effects on Operations
  - Environmental Effects on Target Detection and Communications

TNT/CBE Program at NPS



- **Started in 2003 as "STAN"**
- **Evolved into two components:**
  - **Concept Based Experimentation (CBE)**
    - **Ray Buettner, Chief Scientist (formerly Dave Netzer)**
    - **Main NPS venue is Camp Roberts CA**
  - **Marine Interdiction Operations (MIO)**
    - **Alex Bordetsky, Chief Scientist**
    - **San Francisco Bay area and several other locations**

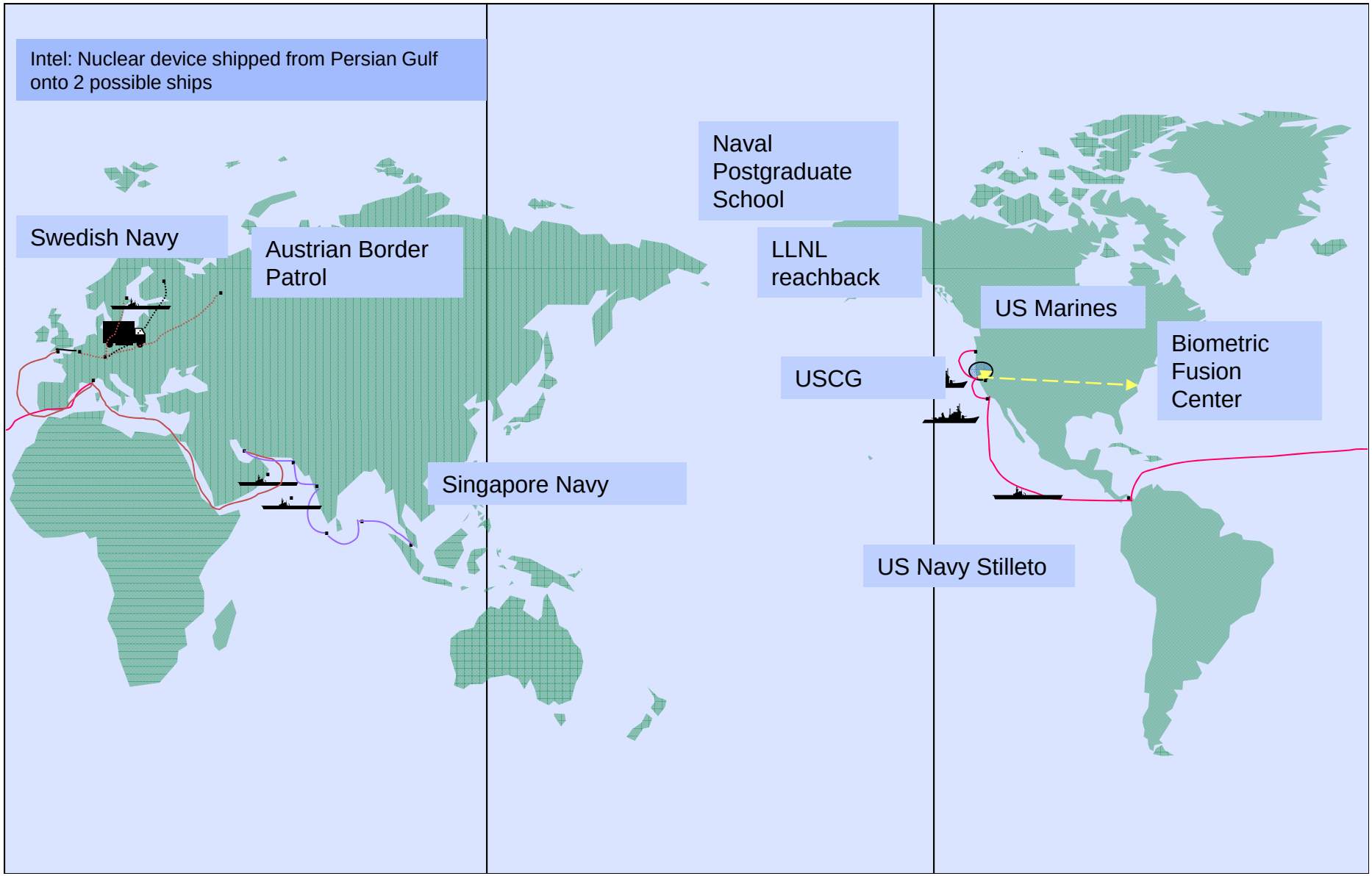
Extending the Tactical Network by Land, Sea, and Air

MIO Experiment Concept

- **Bridging the gap between sensors and actors on the ship, and decision-makers and analysts on the shore**
- **Utilizing COTS networking technology combined with collaborative decision-support tools to compress the timeline of interdiction operations**
- **Exploring Inter-Agency and Coalition collaborative information sharing**

Maritime Interdiction Operations

Example Scenario and Global Partners



NPS-LLNL MIO Cooperation Partners

NPS Team

Networks: ship-to-ship, ship-to-shore

Collaborative Technology

Operations & Command Center

VPN reachback

Unmanned vehicles

Biometrics

Environmental Effects

LLNL Team

HOPS

Export Control

Radiation Reachback

Plume Modeling

Radiation Sources

Radiation Detection

Ultra-wide band Communication

Explosives Detection

Participating DoD and U.S. Gov't.:

-USSOCOM

-OSD/HD

-Biometric Fusion Center

-NIST

-MARAD

-USCG/D-11

-US Marine Corps

-DOE Radiological Assistance Program

-OFT

-DTRA

Foreign Partners:

National University of Singapore/DSTA

Swedish National Defense College/Swedish Naval Warfare Center

Salzburg Research

University of Bundeswehr at Munich

State and Local Government

Alameda County Sheriff

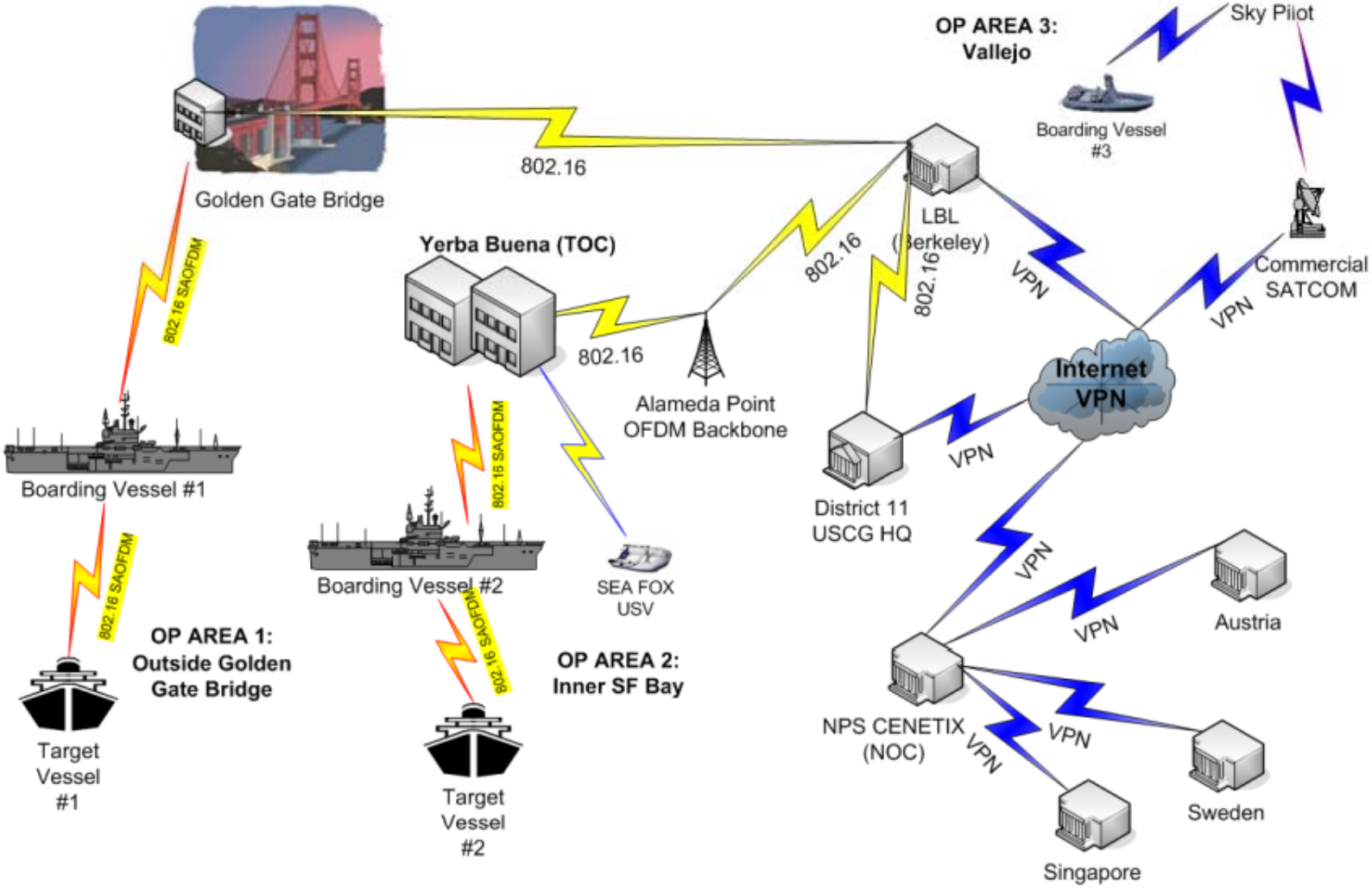
Oakland Police Dept.

San Francisco Police Dept.

California Office of Emergency Services

Network Diagram: MIO

Sep 7, 2007

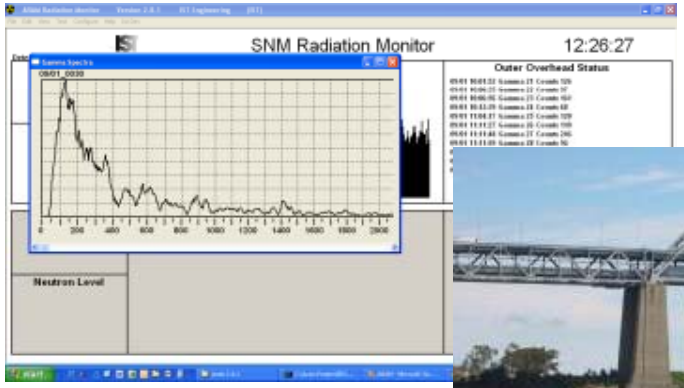


New element: Three Boarding Parties simultaneously conducted in the open waters, inner bay, and the riverine area

ARAM – Adaptable Radiation Area Monitor used for Drive-by detection of Nuclear Materials (Dave Trombino, Brian Agrawal)

- **Real time radiation monitoring system**
- **Spectral data analyzed to quickly provide actionable information**
  - **flow of commerce not impeded**
  - **secondary search possibly not necessary**
  - **Spectra transmitted to reachback**

R&D 100 2005



Drive-by detection of radiation sources in small boats; With Reachback 6/6 sources correctly identified

Small Craft Detection And Interdiction

TNT MIO 09-2

NETWORKING AND INTERAGENCY COLLABORATION ON MARITIME-SOURCED NUCLEAR RADIATION THREAT AND SMALL CRAFT INTERDICTION

San Francisco Bay/ Ft. Eustis, VA/Germany/Sweden

April 20-24, 2009

JOINT NPS-LLNL
FIELD EXPERIMENT SPONSORED BY
USSOCOM, OSD/HD AND HLS S&T MDA
PROGRAMS

MIO 09-2 Objectives

Evaluate the use of networks, advanced sensors, and collaborative technology for rapid Maritime Interdiction Operations (MIO), including the ability to search for radiation sources, set up ship to ship and ship to shore communications while maintaining network connectivity with command and control (C^2) organizations and collaborating in response to the radiological threat in the San Francisco Bay Area and subsequent events in the Riverine area of Hampton Roads, VA.

MIO 09-2 Objectives

The specific goal for MIO 09-2 was to further explore new sensors, unmanned systems, networking, and situational awareness solutions for tagging, monitoring and interdicting small craft and their crews, possessing nuclear radiation threat and persistent detection and monitoring of riverine activities.

MIO 09-2 Scenario

1. Nuclear fuel was stolen from Russian and European Nuclear reactors.
2. Intelligence reports Al Qaida obtained the fuel.
3. Al Qaida issues an ultimatum for the US to withdraw from Afghanistan and Iraq or it will bring the end of the world to “satanic western civilization”
4. Nuclear experts determine that Al Qaida may have developed am improvised nuclear device (IND).
5. A suspect vehicle is tracked from Croatia to Germany. Vehicle is tagged with a trackig device.
6. Suspect device is transferred to vessel proceeding to San Francisco Bay.
7. Vessel is interdicted and searched in SF Bay.

MIO 09-2 Activities

San Francisco Bay

1. Cargo Vessel Search (April 20, 2009)
2. Multiple Craft Small Craft Drive by Search (April 21)

Target Vessel
USS Keystone State

Detection “Procession”

Target vessels

Detection Vessels

MIO 09-2 Activities

Fort Eustis, VA

1. Suspect small vessel tagged by divers (April 23)
2. Threat of tagged vessel evaluated
3. Vessel chase and interdiction (April 24)

Ft Eustis: Defense of a high value ship

- **Friendly forces:**
  - **C2 node**
  - **USVs**
  - **Manned patrol boat(s)**
  - **Unattended sensors**
    - **Ground**
    - **Shipboard**
    - **River**
- **Opposition forces:**
  - **NSW swimmers**
  - **Goal:**
    - **Infiltrate river environment**
    - **place mine-like object on hull**
    - **board the vessel for a topside intel gathering mission**
    - **Infiltrate**

- C2 site (ICARUS based) monitor sensors and USVs & manned vessel patrol of riverine environment.
- Dynamic response of USV and manned vessel to sensor alerts.
- Transition of OPFOR or local Fort Eustis divers to finding and reporting via network suspect object attached to hull.
- C2 actions to coordinate response and cordon off and search area with USV and manned boat(s).
- Conduct high speed chase of suspect enemy support vessel

Ft Eustis Area

Environmental Effects

Peter Guest, PI
Kenneth Davidson
Mary Jordan
Dick Lind

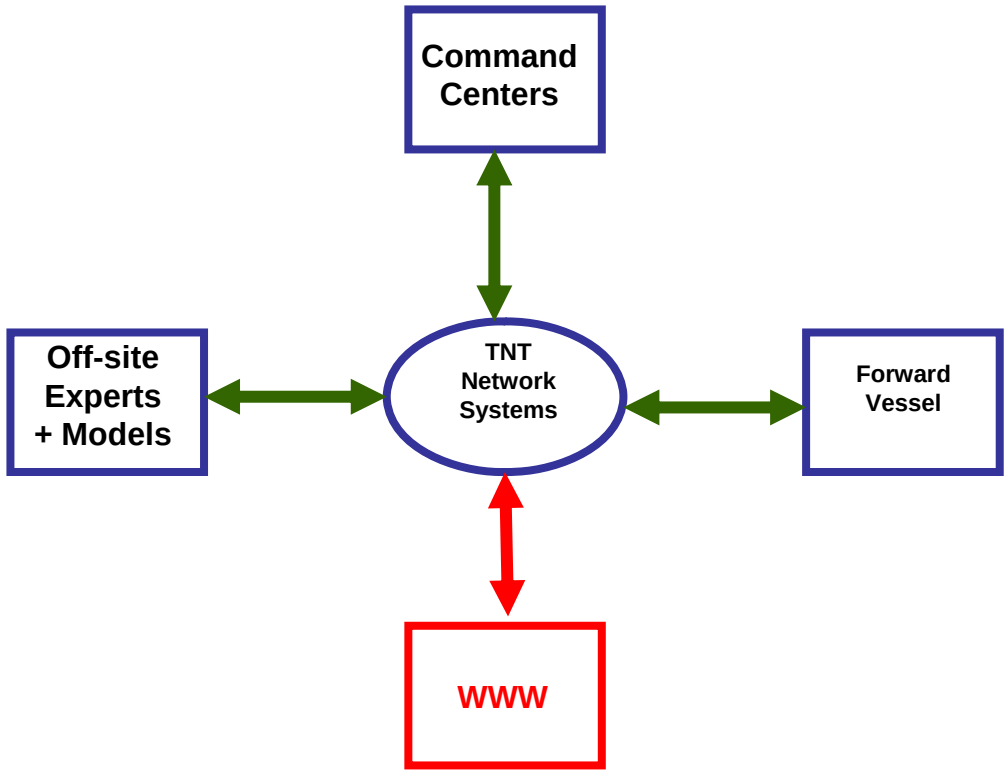
1. Support: Ongoing Operations

- Morning Weather/Sea State Briefs
- Website
- Radar Range Predictions
- Visible Range Predictions

2. Research: Improving Detection Range Models

- Visible detection

Flow of Environmental Information During MIO 09-2



Model Predictions During MIO 09-2

Raw Data Sources

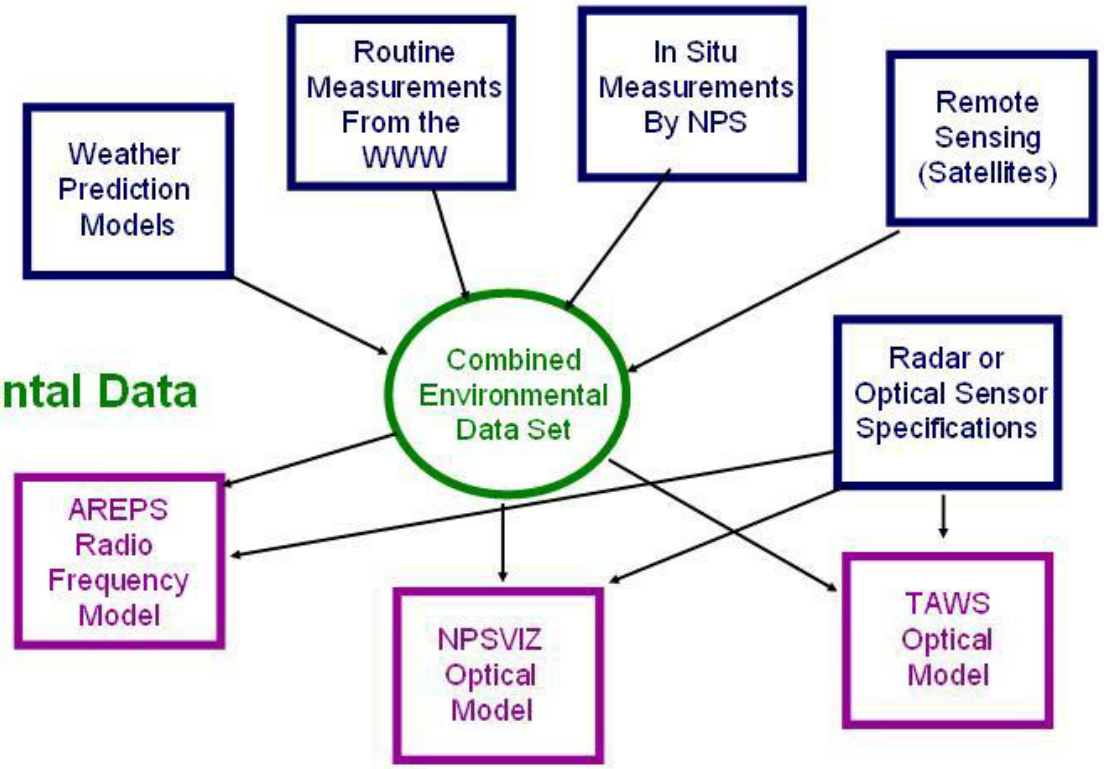
This is where the initial information comes from.

Processed Environmental Data

This is derived from above.

Effects Models

These predict detection ranges.



Weather/Sea State Brief

San Francisco Bay

- April 20: Keystone State Conference Room
- April 21: Yerba Buena Coast Guard Station

Key issue: Hot Weather

Fort Eustis, VA

- April 23: Remote Presentation using Groove and email
- April 24: Remote Presentation using Groove and email

Key issue: Waves affecting Swimmers and Divers

Website

San Francisco Bay

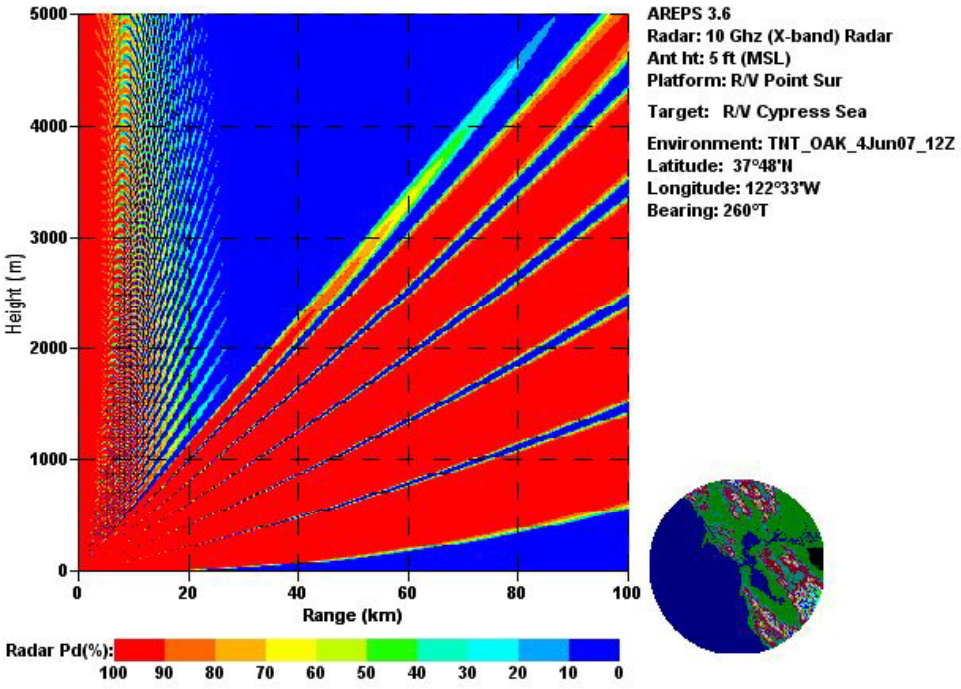
Fort Eustis, VA

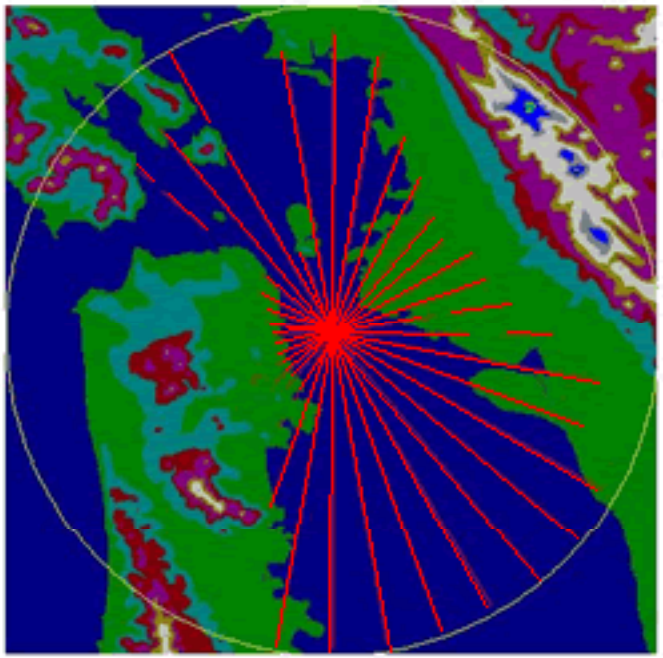
http://www.met.nps.edu/~psguest/tntmio/

AREPS Radar Range Predictions

San Francisco Bay

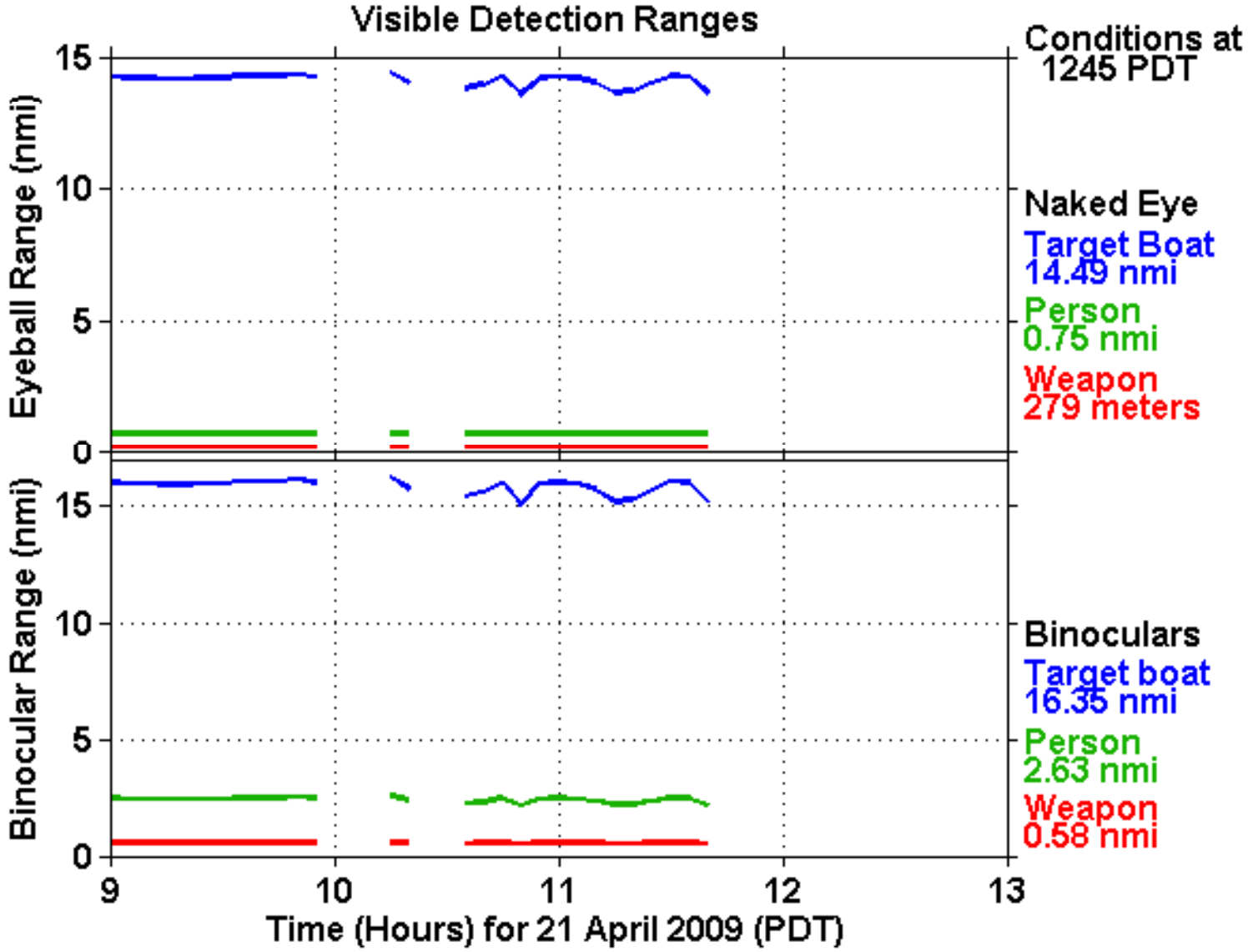
TNT MIO 21 April, 2009





Based on upper-air radiosonde launched from OAK

Visible Range Predictions
NPSVIZ

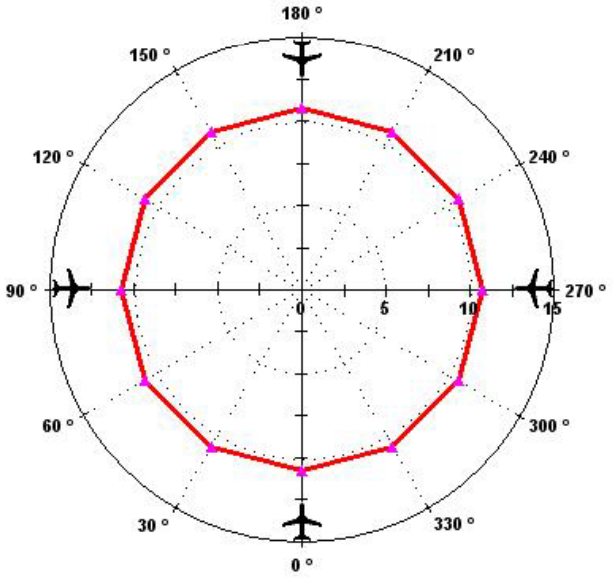


Visible Range Predictions
TAWS
San Francisco Bay

UNCLASSIFIED

Slant Range (km) vs Azimuth Angle (deg)

30 ft Altitude (AGL) Maximum Detection Range 75 % Probability Direct Light Sky Background
1900 UTC Fishing Boat (90 ft), Steel, Gray 90° Target Heading



37° 48' 00" N 122° 33' 00" W **21 April 2009** Sensor 3000
Illumination (almanac) 97169200.0 mlux
Illumination (weather) 84670912.0 mlux
Solar Elevation 69 °

UNCLASSIFIED

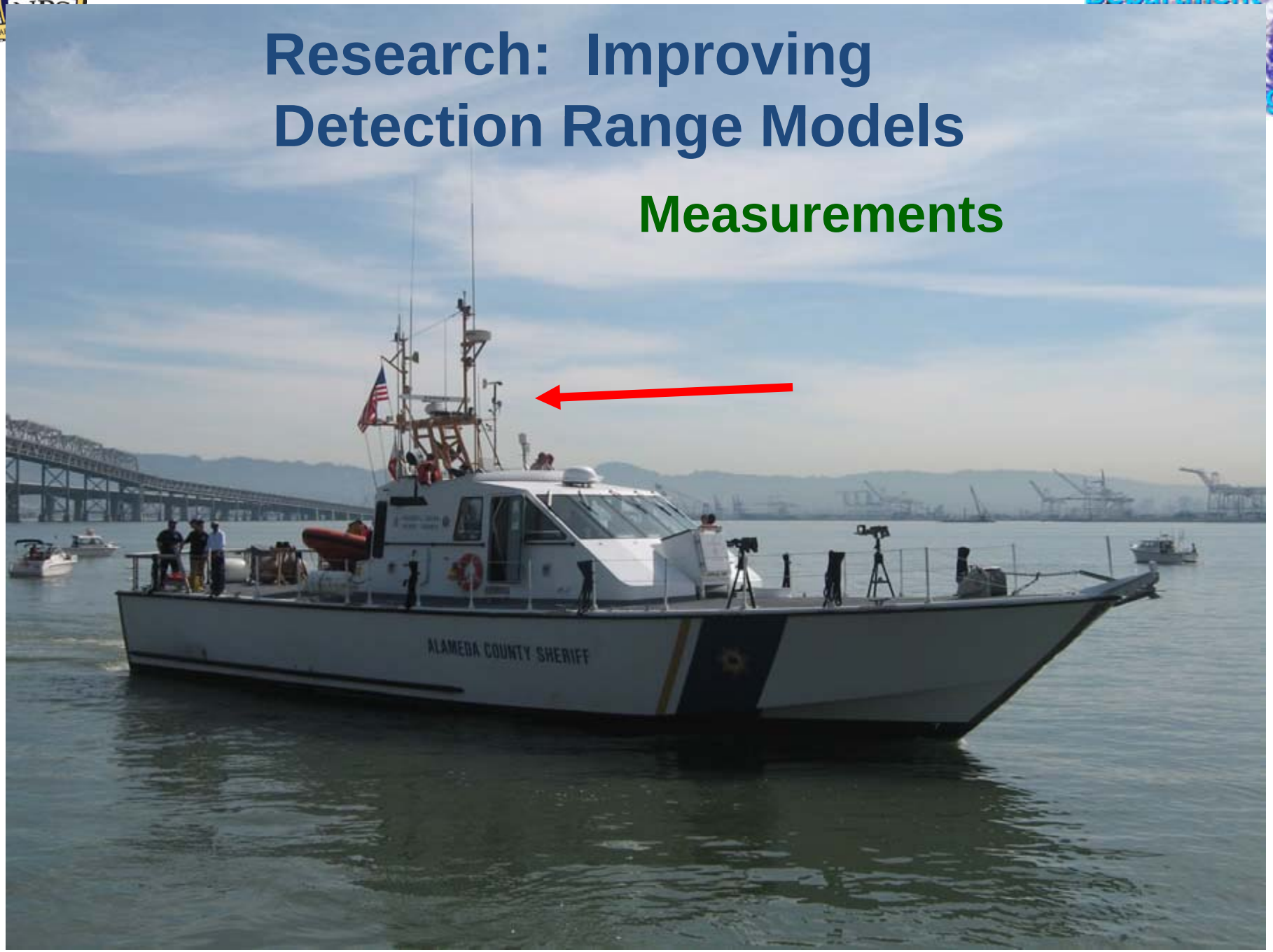
Research: Improving Detection Range Models

Data Collection

1. In Situ Measurements
2. Model Results
3. Visibility Range Photography
4. Surrounding Environmental Information (from WWW)

Research: Improving Detection Range Models

Measurements



Research: Improving Detection Range Models

Measurements

Wind Vector

Temperature

Humidity

Compass

GPS

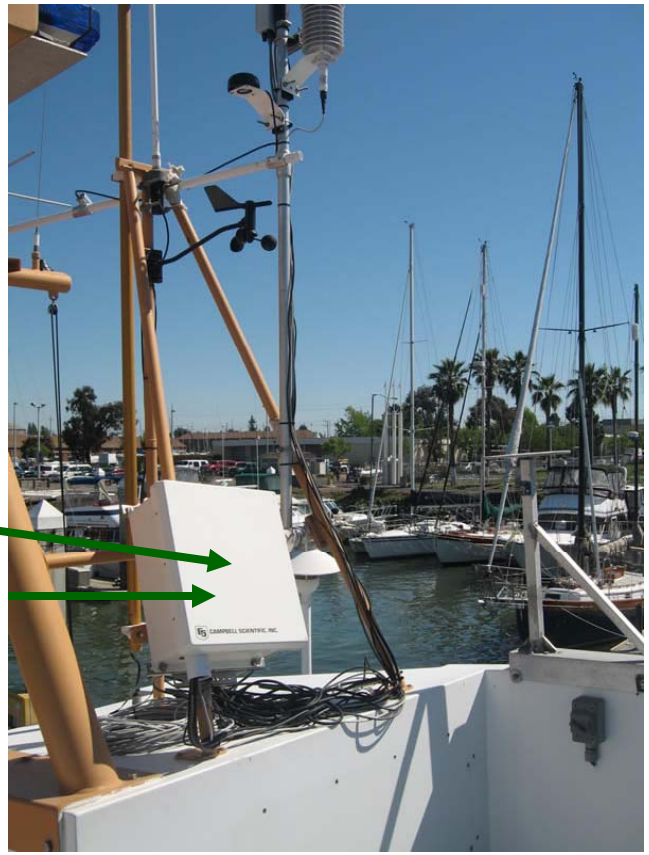
IR Sea Temp

Pressure

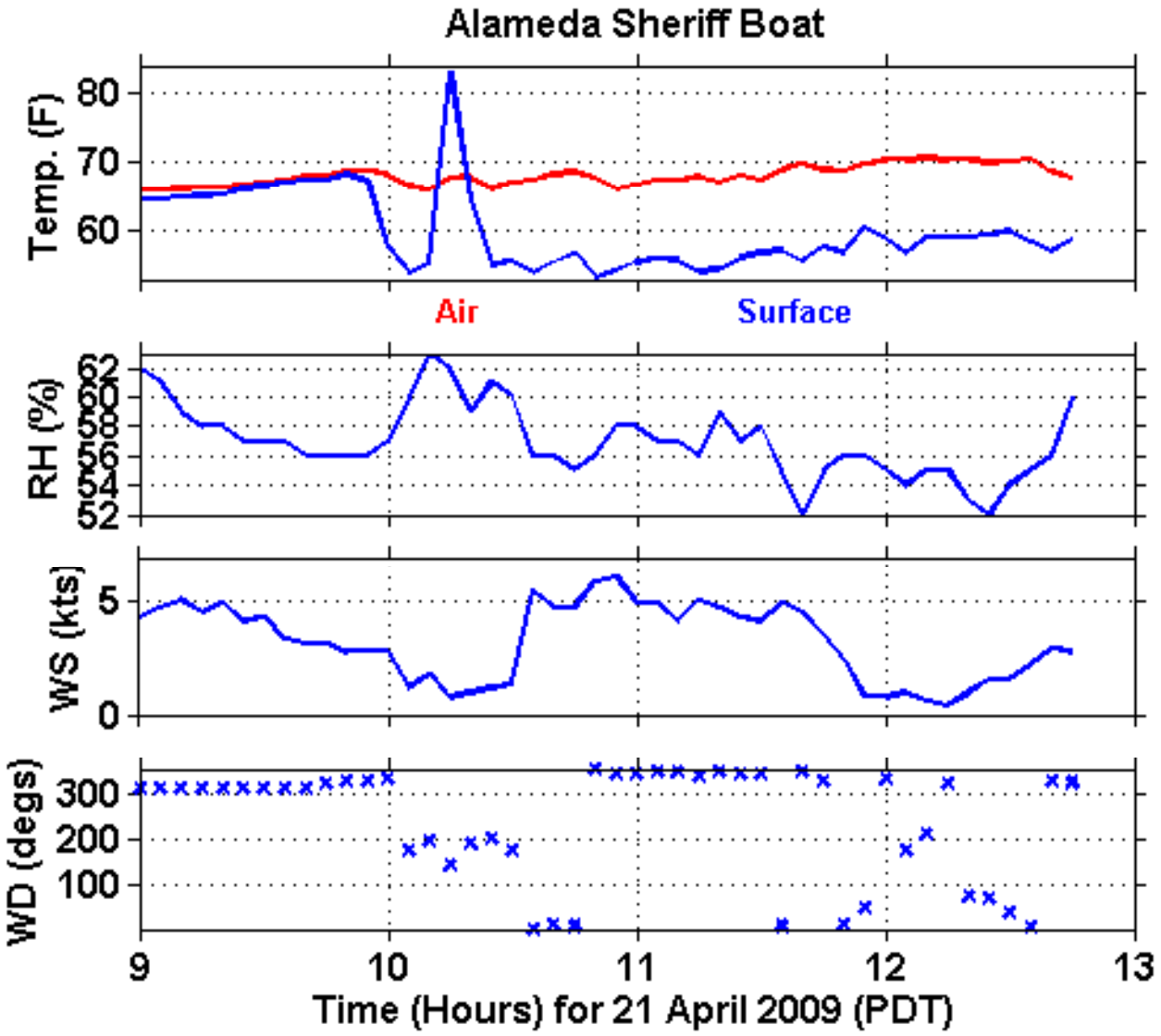
Data Acquistion System

Network Node (below deck)

SST (bucket)



Meteorology Conditions



Research: Improving Detection Range Models

Optical Turbulence - Over land situation

Sunrise

Sun heats surface which causes surface-air temperature contrast.

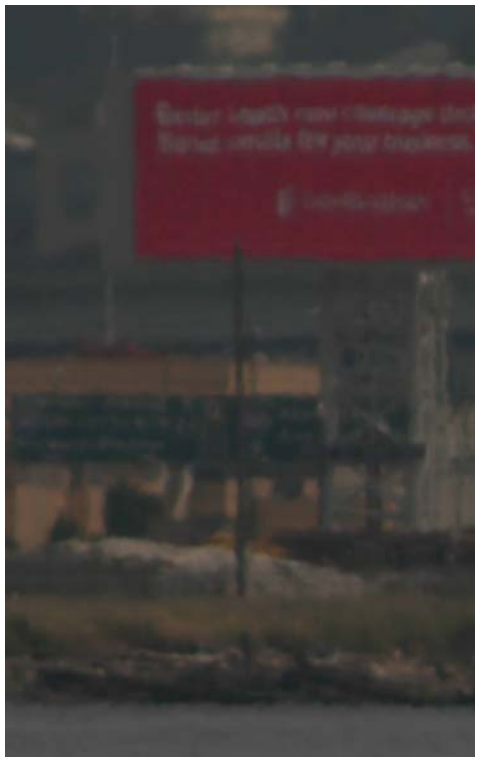
4 hours later

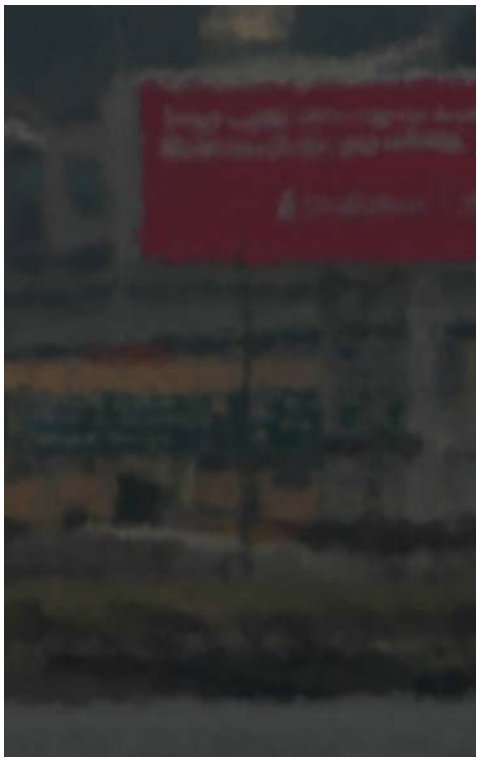
Wind tends to equalize temperatures and suppress turbulence

Research: Improving Detection Range Models

Optical Turbulence - Over water situation

Across the bay using 1000 mm lens





U = 1 kts
1232 PM

U = 7 kts
1406 PM

April 21, 2009

Sun cannot significantly change surface temperature

Wind brings warmer air over cold water surface and causes increase in optical turbulence

Environmental Effects Support and Research During MIO 09-2

Conclusions

1. All measurements successful
2. Main weather effects:
   - Heat (SF Bay) - forecasted
   - Waves (Ft Eustis) – not forecast
3. Radar Range not verifiable
4. Visible range predictions reasonably accurate
   - Need to include 1000 m camera
5. Interesting Optical Turbulence effects due to advection of warm air over cold water

The End